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when the latter are present as a sulphate. The process is well founded on known principles, and the phenomena accounted for are among the most common and heretofore most puzzling encountered in mining. The solving of this difficulty is likely to be of the highest practical utility.

Mr. Lindgren's paper on metasomatic processes gives sharp definition to many heretofore hazy phenomena and will be of considerable utility both in the development of theory and practice.

In general, the volume is notable in that for the first time the results of recent investigations in physical chemistry are applied to the solution of the problems of ore genesis. The results attained are most promising, and open up enticing vistas of what may be expected from further investigations along these lines. For example, the question may be asked whether, in seeking an explanation of the chemical problems involved, we have not relied too exclusively upon the influences of heat and pressure. If we keep in mind the very large place in the field of research which the diminutive ion now holds, and the close relations obtaining between ions and electric forces, one may well question whether here is not a fruitful field for investigation. The startling results already obtained in physiological investigations by studying the operation and effects of the electro-motive force hint at perhaps equally important results awaiting the investigator in other fields.

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SUMMARIES OF THE LITERATURE OF STRUCTURAL MATERIALS. I.

EDWIN C. ECKEL.

UNDER this heading the writer purposes to summarize at intervals the literature relating to the economic geology of building stone, road materials, cements, lime, gypsum, clays, etc. Except when the word "comment" expressly appears, the matter presented will be simply a summary of the statements and opinions appearing in the paper under discussion. The writer will endeavor to indicate briefly the scope of each paper, following this by a résumé of the *original* matter contained in it.

BABCOCK, E. J. *Clays of Economic Value* (*in North Dakota*). First Report North Dakota Geol. Surv. Pp. 27–55, 3 plates, 1901.

The clays of North Dakota are derived from the Pleistocene, the Laramie, and the Fort Pierre division of the Cretaceous. The Pleistocene clays include the yellow and blue brick clays of the Red River valley; the stoneware clays and fire clays of Dickinson and the clays of Minot and Plenty Mine are probably Laramie; while the shales about Park River and the Pembria Mountains are in the Fort Pierre. Analyses of European and New Jersey clays are quoted, with notes on the qualities requisite for the various clay products. Detailed descriptions of North Dakota clays, with analyses and tests, are then given.

Clays suitable for the manufacture of common brick are widely distributed, and plants are in operation at Fargo, Minot, Bismarck, Burlington, Grand Forks, Drayton, and many other places.

Near Minot, at Bismarck, in Mercer county, and at the Lehigh mine, clays occur which are adapted to use in the manufacture of pipe, tile, and terra cotta. None of these are at present used.

Fire clays and stoneware clays are found at only one locality in the state, near Dickinson, Stark county. These clays are in the Laramie, and outcrop in quantity on the bluffs near the town. A large fire-brick plant is now in operation at this point, the product being of very high grade.

BLATCHLEY, W. S. *Oolite and Oolitic Stone for Portland Cement Manufacture.* Twenty-fifth Ann. Rept. Indiana Dept. Geol. and Natural Resources. Pp. 322–330, Pl. 13, 1901.

Pure limestones occur in Crawford, Harrison, Washington, Lawrence, Monroe, and Owen counties, Indiana. Analyses show that the lime carbonate usually exceeds 95 per cent., with rarely more than 1 per cent. magnesium carbonate. Clays and shales of suitable quality are, in many places, near the limestones. Several companies have been organized to utilize these limestones and clays in the manufacture of Portland cement.

BUCKLEY, E. R. *The Clays and Clay Industries of Wisconsin.* Bulletin 7, Part I, Wisconsin Geol. and Nat. Hist. Surv. 8vo, pp. 304, Pl. 55, 1901.

Chapters on the origin, composition, classification, and properties of clays precede detailed descriptions of the clay deposits and industries of Wisconsin.

Buckley discusses previous classifications and offers a scheme based primarily on origin and secondarily on position :

I. Residual, derived from
  a. Granitic or gneissoid rocks.
  b. Basic igneous rocks.
  c. Limestone or dolomite.
  d. Slate or shale.
  e. Sandstone.
II. Transported, by
  a. Gravity assisted by water.
    Deposits near the heads and along the slopes of ravines.
  b. Ice.
    Deposits resulting mainly from the melting of the ice of the Glacial Epoch.
  c. Water.
    1. Marine.
    2. Lacustrine.
    3. Alluvial.
  d. Wind.
    Loess.

The residual clays of Wisconsin are not of much economic importance except in the driftless area, where clays resulting from the decomposition of limestone are extensively worked for brick manufacture. Glacial clays are important in the northern part of Wisconsin, and include some of the best and some of the poorest clays of the state. In the clays of marine origin are included the shales of the Cincinnati and Potsdam periods. The Cincinnati series has a thickness of 165 to 240 feet, and consists of interbedded limestone and shale. The shale varies greatly in composition and in hardness. Near the base of the Potsdam in the central part of the state occur interbedded layers of very soft plastic blue to brownish clay and coarse-sandstone.

The lacustrine clays are perhaps the most extensive in the state. They are partly of interglacial, partly of immediately postglacial age; and in some places the clays and interbedded tills have a depth of one hundred feet or more. This thickness is not composed entirely of water-sorted material, but includes a considerable thickness of bowlder clay with pebbles of igneous rock and limestone.

River deposits of varying age are common, and furnish much clay for brick manufacture. In composition these clays vary with the rocks of the drainage basin in which they were formed, the clays of the west central part of the state being the least calcareous.

In Dunn and St. Croix counties extensive deposits of pure white kaolin occur, probably derived from the igneous rocks to the northeast and deposited by water prior to the first glacial epoch. These clays are of the highest grade, but are now shipped exclusively for use in the manufacture of paper.

Wind-borne clays are of doubtful occurrence, and in the few cases where æolian transportation seems probable, the resulting deposits are of no economic importance.

KÜMMEL, H. B. *Report on the Portland Cement Industry* (in New Jersey). Ann. Rep. N. J. State Geologist for 1900. Pp. 9–101, Figs. 1–33, Pls. 1–2, 1901.

The first chapter of this report is a discussion of the composition and materials of Portland cement in general; the second is devoted to the geologic relations of the Cambro-Ordovician rocks of Warren and Sussex counties; and the third contains detailed descriptions of the areas of Trenton limestone ("cement rock"), with notes on other limestones and the white marl deposits of New Jersey.

Overlying the relatively thin Hardiston (Lower Cambrian) quartzite of the Kittatinny valley is the great magnesian limestone series which has been described as the Kittatinny limestone by Weller and Kümmel, and as the Wallkill limestone by Wolff and Brooks. The Kittatinny limestone is usually blue, though often varying to gray drab, or even black. It is fine, even-grained, often minutely-crystalline. It usually contains 15 to 20 per cent. of magnesium carbonate, and is therefore not available for use in the manufacture of Portland cement.

Resting on the eroded surface of the Kittatinny limestone, and often commencing with a basal limestone conglomerate, is the dark blue, fossiliferous Lower Trenton limestone. Unlike the Kittatinny, it is never magnesian, but many of its beds are shaly. These shaly beds, carrying 65 to 75 per cent. lime carbonate (the remainder being silica and alumina), are the "cement rocks" which form the basis of the great Portland cement industry of New Jersey and Pennsylvania. The lime carbonate needed to carry them up to the proper composition is obtained from other beds (of purer limestone) occurring in the Trenton.

Detailed descriptions, with maps and analyses, of the exposures of Trenton limestone are given in the final chapter of the report. Certain limestones of higher horizons are also discussed in this connection, as are the deposits of white shell marls.

LEE, H. A. *Mineral Resources of Colorado — Larimer County Gypsum.* Stone, Vol. XXI, pp. 35–37, 1900.

Larimer county is the largest gypsum producer in Colorado. The gypsum deposits are associated with rocks of Jura-Cretaceous age, and occur in a basin between rocky ridges. The main quarry is operating on a knoll showing a face of gypsum 250 feet long, and 28 feet high in the middle, thinning to 7 feet at the edges. The gypsum is quite compact and gray in color. The amount of stripping does not exceed 18 inches. The material is blasted out, auger holes being bored to receive the charge of explosive.

The mill of the Consolidated Plaster Co. has a capacity of 40 tons per day of ten hours. It is built on a side hill and the gypsum is received from wagons at the top of the mill, fed through coarse and fine crushers, and then over screens to buhrstone mills. From these it is carried to five-ton kettles, two and a half hours being consumed in charging, "boiling," and discharging. No details are given concerning the retarders used.

MCCALLIE, S. W. *Preliminary Report on the Roads and Road-Building Material of Georgia.* Bulletin 8, Georgia Geol. Surv., 8vo, pp. 264, Pls. 1–27, Figs. 1–28, geologic map, 1901.

The chapters of this bulletin fall naturally into three groups, treating respectively the subjects of road construction in general; the topography and geology of Georgia in relation to road construction and road building materials; and the methods of road making in the various counties of the state. The first of these groups includes chapters on the history of road construction; the value of good roads; the theory of road making, as regards locations, grades, and surfaces; the maintenance and repair of roads; the considerations governing the selection of road materials; and the tools and machines used in highway construction. These chapters furnish an excellent summary of the general subject of road making.

In the second group fall chapters on the topography of Georgia in its relation to the highways, and on the road-building materials of Georgia. A colored map shows the areas covered by the crystalline, the Palæozoic, and the Cretaceous and Tertiary rocks; and the location of the trap-dykes which occur in the crystalline area.

The Palæozoic area is divided topographically, following Hayes, into the plateau, sharp ridge and valley region. The plateaus have a level surface, but terminate in steep escarpments. Owing to the steepness of these escarpments, it is difficult to carry a road by easy grades from the valleys to a plateau, but when the elevated areas are reached the cost of construction is slight. The plateaus also affect road work by acting as barriers to free communication between their bordering valleys. The second type of surface consists of a number of sharp, parallel ridges, trending northeast and southwest, and due to the weathering of the upturned edges of hard sandstone (which, in the plateau region, lies almost horizontal). The smaller ridges are frequently intersected by streams along whose valleys cross country roads of easy grade can be constructed, while the main roads are located in the valleys, which offer no serious obstacle to construction. The valley region consists of low, wide, comparatively level valleys, in which highway construction is simple.

The crystalline area is divided into two regions — the mountainous and the plateau. The former consists of rugged peaks separated by narrow valleys, in which flow rapid streams; and road construction and maintenance is difficult and expensive. In the plateau region highway construction is easy, as light grades can be obtained, and the cost of grading is slight owing to the deep decomposition of the underlying rocks.

The Tertiary area is a plain, sloping gently southward, and traversed by large streams. Swamps and depressions along stream valleys offer the only serious obstacles to road construction which, except in these places, is very inexpensive.

The road materials occurring in the Palæozoic area are limestones, cherts, shales, and sandstones. The limestones of the area are abundant and well suited for road-metal. They are all of the Silurian age, and occur in three different formations; the Knox dolomite, the Chickamauga limestone and the Bangor limestone. Of these the first is the most important, owing to its thickness and areal extent. It is easily quarried and crushed and furnished excellent road metal. Some beds of the Chickamauga formation supply good material, as does the Bangor limestone. The areal extent of this last formation is, however, too small to make it of importance.

The Palæozic cherts are widely distributed and extensively used. They occur in both the Knox dolomite and the Fort Payne chert. The material is well suited to roads of light traffic, but inferior to limestone where the traffic is heavy. It binds well but becomes dusty in dry weather. The chert is often located favorably for working and transportation.

The shales and sandstones of the Palæozoic are locally used, but are not satisfactory material.

In the crystalline area the rocks available for road work are granite, gneiss, diotite, trap schist, quartzite, and marble. Of these the last three are unsatisfactory as road metals. The granites, and the less well-laminated gneisses and diorites, furnish fair macadam. The trap dikes which are widely distributed in the crystalline area› furnish excellent material. These diabases are dark gray to black, fine grained, and very tough. At present this material is little used, but will probably become important.

The Tertiary area supplies limestone, buhrstone, and gravel. The limestones consist of shell fragments, with some sand, in a calcareous matrix. They have been used extensively in southern Georgia, and are very satisfactory, cementing readily into a compact, hard surface, comparatively free from dust. Buhrstone is of little use. The gravels cemented by ferruginous clays make durable and very satisfactory roads, and are largely used.

NEVIUS, J. N. *Roofing Slate Quarries of Washington County, New York.* Nineteenth Rept. N. Y. State Geologist. Pp. 135–150, Pls. 26–37, 1901.

Gives detailed descriptions of the slate quarries and quarry methods and a discussion of the general features and condition of the industry. The working quarries are located along an approximately north and south line which extends from the Hampton variegated quarries on the north, through the North Bend, Middle Granville, Granville red and the Slateville red and green quarries, and the purple and green quarries of Salem, Shushan and Cambridge. The East Whitehall (Hatch Hill) quarries are west of the northern end of this belt.

The red and green slates are cut to size at the mills. The mottled slates, being unsalable in the natural condition, are "marbleized," an enamel being applied to give imitations of marbles, etc. The refuse from the slate mills is ground and used as a pigment.

PECK, F. B. *Preliminary Notes on the Occurrence of Serpentine and Talc at Easton, Pa.* Annals N. Y. Acad. Sci., Vol. XIII, pp. 419–430, Pl. 16, Figs. 4, 5, 1901,

Chestnut Hill is a pre-Cambrian outlier near Easton, composed of a dense hornblende gneiss with interstratified beds of carbonates. These beds, five to thirty feet thick, consist of pink calcite, gray dolomite, or a mixture of the two. Along a series of thrust faults great shearing has occurred. Hornblende (usually tremolite), phlogopite, and occasionally pyroxene, occur so abundantly in these beds as locally to replace all or most of the carbonates. The calcite dolomite beds shear to a slaty, foliated talcose mass consisting of a mixture of talc, tremolite, serpentine, or without shearing, become changed to beds of nearly pure white tremolite. The phlogopite, which is developed locally in large quantities, alters quite uniformly to serpentine and constitutes the chief source of that material in the eastern quarries. One particularly attractive phase of the material quarried consists of numerous rose-colored dolomite crystals scattered through a mass of serpentine.

RIES, HEINRICH. *The Origin of Kaolin.* Trans. Amer. Ceramic Soc., Vol. II, 1900.

The author defines the kaolins as "those clays which are residual in their nature, and which burn to a sufficiently white color to be used in the manufacture of white earthenware." Thus restricted, two different modes of origin of kaolins are discussed. In most cases kaolin has been derived from the decomposition of a highly feldspathic rock, through the action of surface agencies. Von Buch, Daubree, and Collins have, however, pointed out that acid vapors (particularly that of hydrofluoric acid) coming up from below, may decompose feldspar and yield kaolin. Deep deposits, especially if containing unaltered sulphide minerals, may have been formed in this way, and the kaolins of Cornwall, England, and Zittlitz, Bohemia, have been undoubtedly so formed. All the commercially valuable deposits of the United States, however, are of the other type, being due to ordinary weathering.

RIES, HEINRICH. *Clays and Shales of Michigan.* Geol. Surv. of Mich., Vol. VIII, Pt. I, 8vo, pp. 67, Pl. I–IV, Figs. 1–6, 1900.

That part of the work relating specifically to Michigan is preceded by chapters on the origin, properties, uses, and methods of testing clays and shales. Following these are discussions of the shales and clays of Michigan.

The important shale horizons of the state are four: the Coal-measure shales, the Michigan series, the Coldwater shales, and the St. Clair shales. The Coal-measure shales are usually interbedded with the coal seams; though known to the miners as fire-clay, they are not very refractory. At Grand Ledge they are utilized for the manufacture of tile and sewer-pipe, and at Saginaw for paving brick. The shales of the Michigan series form a belt ten to twenty miles in width surrounding the Carboniferous area in the Lower Peninsula. They are best shown at Grand Rapids, where they form a bed six to ten feet thick overlying the gypsum. They are suited for common brick manufacture, for which they are at present used. The Coldwater shales are extensive and important, being used in all the Portland cement plants of the state. For this use they have been quarried extensively at Bronson, Union City, and Coldwater. According to laboratory tests, these shales show the properties desirable in the manufacture of vitrified wares. The St. Clair shales outcrop southeast of East Jordan. They weather to a tenacious clay and burn to a good red color. At Alpena a clay shale of the Traverse (Hamilton) series is used in the manufacture of Portland cement, and tests prove it to be suitable for the manufacture of high-grade brick.

The clays of the state are all Pleistocene, and represent three types: morainic or drift clays, lake clays, and river silts. The morainic clays are invariably calcareous, while the lake clays are very frequently so. The river silts are less likely to be calcareous, but are usually gritty. Morainic clays are used in the manufacture of pottery and brick at Ionia, Lansing, and Kalamazoo. The extensive brick clay deposits near Detroit are lacustrine in origin, while at Rockland a lake clay furnishes slip. At Sebewaing, Badoxe, Croswell, and Minden City river clays are used in the manufacture of brick.

RIES, HEINRICH, AND SMITH, EUGENE. *Preliminary Report on the Clays of Alabama.* Bulletin 6, Alabama Geol. Surv., 8vo, pp. 220, 1900.

This bulletin is divided into three sections. The first and third — entitled respectively "General Discussion of Clays" and "Preliminary Report on the Physical and Chemical Properties of the Clays of Alabama"— are by Ries; the second, entitled "Geological Relations of the Clays of Alabama," is by Smith.

The first section discusses the origin, mineralogy, chemical, and physical properties, methods of testing, mining, and preparation of clays.

In the second section the clays of the various geologic formations of Alabama are described. Under the head of "Archæan and Algonkian" the residual kaolins are discussed. A belt of mica schists with frequent pegmatite veins extends from Cleburne and Randolph counties through Clay and Coosa into Chilton county. In numerous cases the decay of the granite veins has given rise to kaolin deposits. All these deposits are distant from railroads, and are consequently undeveloped.

In the area underlain by the Cambrian and Silurian rocks the clay deposits are the residual clays left from the decomposition of the limestones of these formations, or concentrations of these residual clays by redeposition in ponds and other depressions, or accumulations in depressions of kaolins derived from the pegmatites above mentioned. The residual clays usually contain much silica and iron, and are largely used in the manufacture of brick. Occasionally, in the re-deposited clays, sorting has occurred during redeposition, and beds of very pure clay occur in consequence.

Thick deposits of pure white clay, suitable for stoneware and pottery, are found in the area underlain by the sub-Carboniferous in De Kalb and Calhoun counties. These are extensively mined, most of the product being shipped to Chattanooga, Tenn.

In the Carboniferous the clays underlying the coal seams have been utilized in the manufacture of pottery and firebrick at several points. Other Carboniferous shales are adapted for use in manufacturing vitrified and pressed brick and terra-cotta.

The lowermost division of the Cretaceous — the Tuscaloosa formation — carries important clay deposits. The strata composing the Tuscaloosa are prevalently yellowish and grayish sands, but subordinated to these are pink and purple sands, thinly laminated dark gray clays with leaf impressions, and great lenses of massive clays varying in quality from pure white-burning clays to dark purple and mottled clays high in iron. The Tuscaloosa occupies a belt of country extending from the northwestern corner of Alabama, where it is thirty or forty miles wide, around the border of the Palæozoic area to the Georgia state line at Columbus, where it is only a few miles in width. East of the Alabama river the proportion of clay to the rest of the strata is less than west of that river, and the clays themselves are more sandy. The purest clays are found in Fayette, Marion, Franklin, and Colbert counties. The clays above described have been long used for stoneware and pottery.

Fire clays are abundant in the lower Claiborne division of the Tertiary, in Choctaw, Clarke, and Conecuh counties. The Tertiary and post-Tertiary clays have not, however, been investigated in much detail.

Over the greater part of the coastal plain, in the river "second bottoms," yellow loams occur which are used for the manufacture of common brick. Lenses of pure plastic clays are also found in many places interstratified with Pleistocene sands.

In the third section Ries discusses the qualities requisite in clays designed for different uses, and gives detailed records of the tests and analyses of seventy-two Alabama clays.

SLOSSON, E. E., AND MOUDY, R. B. *The Laramie Cement Plaster.* Tenth Ann. Rept. Wyoming College Agri. & Mech, 1900.

The Laramie cement plaster is made from gypsum obtained a short distance south of Laramie, Wyo. The Triassic beds of the region contain much gypsum, one particular stratum of considerable thickness occurring near the base of the Trias, about two hundred feet above the Permian sandstone. The disintegrated gypsum from the outcropping edges of these beds has been washed down and redeposited in depressions in the plains. These gypsite deposits contain a considerable percentage of impurities, chiefly silica and lime carbonate. The Laramie gypsite bed has an average depth of about nine feet. The upper seven feet is pure gypsite, underlain by a "red layer" five inches thick, below which is a foot or more of gypsite resting on gravel and clay.

The Laramie cement plaster is made by the kettle process, the temperature being carried to 380–390° F. An analysis of it showed:

Ultimate.		Probable Combinations.]	
SiO_2	5.50	$CaSO_4$	73.73
Al_2O_3	0.59	$CaCO_3$	7.86
CaO	37.11	CaO	2.35
MgO	1.45	$MgCO_3$	3.04
SO_3	43.37	SiO_2	5.50
CO_2	5.05	Al_2O_3	0.59
H_2O	6.93	H_2O	6.93

The dehydration is evidently not carried far enough. Experiments show that the common cactus (Opuntia platycarpia) and malva (Malvastrum coccineum), when dried and ground, form cheap and satisfactory retarders. Tests for tensile strength show that all retarders decreased the strength of the plaster.